MODULE 1
DISTRIBUTION OF THUNDERSTORMS

OBJECTIVES

At the completion of this module, the student will be able to:

1) Identify which areas of the country experience the most thunderstorm occurrences
2) Trace the seasonal march of thunderstorm occurrence across the United States
3) Identify at what time of the day thunderstorms are most likely to develop

SPATIAL DISTRIBUTION

Thunderstorms, which simply are local storms accompanied by lightning and thunder that oftentimes produce strong gusts of wind, heavy rainfall, and hail, occur quite frequently on a global scale. It is estimated that there are as many as 40,000 thunderstorm occurrences each day world-wide. This translates into an astounding 14.6 million occurrences annually!

The United States certainly experiences its share of thunderstorm occurrences. Figure 1-1 shows the average number of days each year in which thunderstorms are observed throughout the U. S. The most frequent occurrence is in the southeastern states, with Florida having the highest incidence (70 to 90 thunderstorm days per year). It is in this part of the country that warm, moist air from the Gulf of Mexico and Atlantic Ocean (which we will see later are necessary ingredients for thunderstorm development) is most readily available to fuel thunderstorm development.

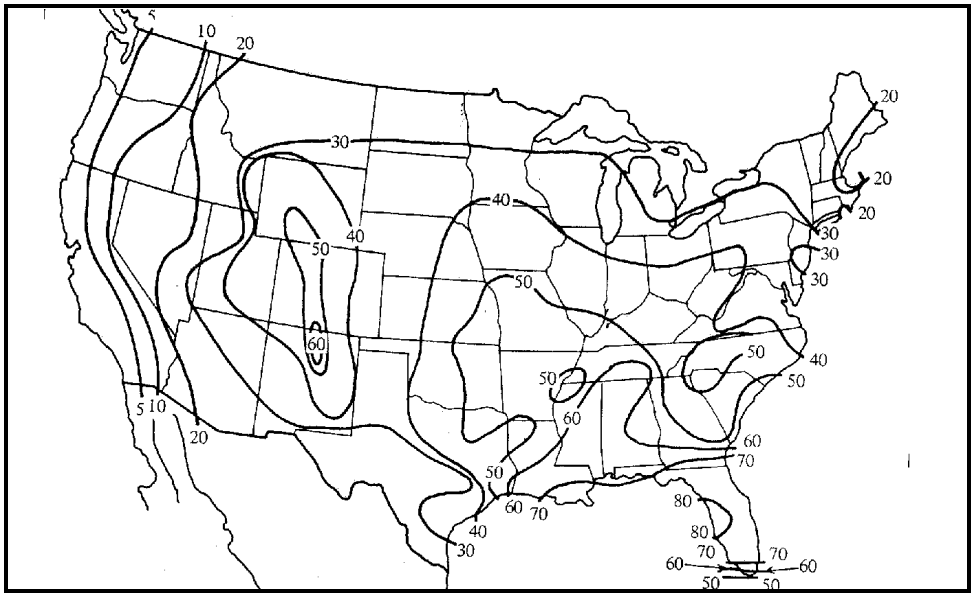

Figure 1-1: The annual frequency of thunderstorms in the United States.

Also note in the figure that the maximum frequency of occurrence over the southeastern states does extend westward toward the Central Plains. Again, the Gulf of Mexico serves as the source region for moisture that, during certain times of the year, rapidly spreads northward in response to episodes of deep low pressure and associated strong southerly surface wind. This scenario is rather common in and around the Dallas-Fort Worth (DFW) metroplex, especially during the spring and early summer. The DFW area, on average, experiences 45-50 thunderstorm days annually.

The frequency of occurrence of thunderstorms decreases significantly as one moves north and west where moisture availability is limited. The exception is along the front range of the Rocky Mountains. Here strong daytime heating during the summer and favorable low-level wind directed toward the mountains help initiate thunderstorm development.

TEMPORAL DISTRIBUTION

We have briefly examined <u>where</u> thunderstorms are most likely to develop. But, what about <u>when</u> are they most favored to develop? Let's first discuss the seasonal march of thunderstorm occurrence, giving particular attention to the production of severe weather (large hail, damaging surface wind, and tornadoes).

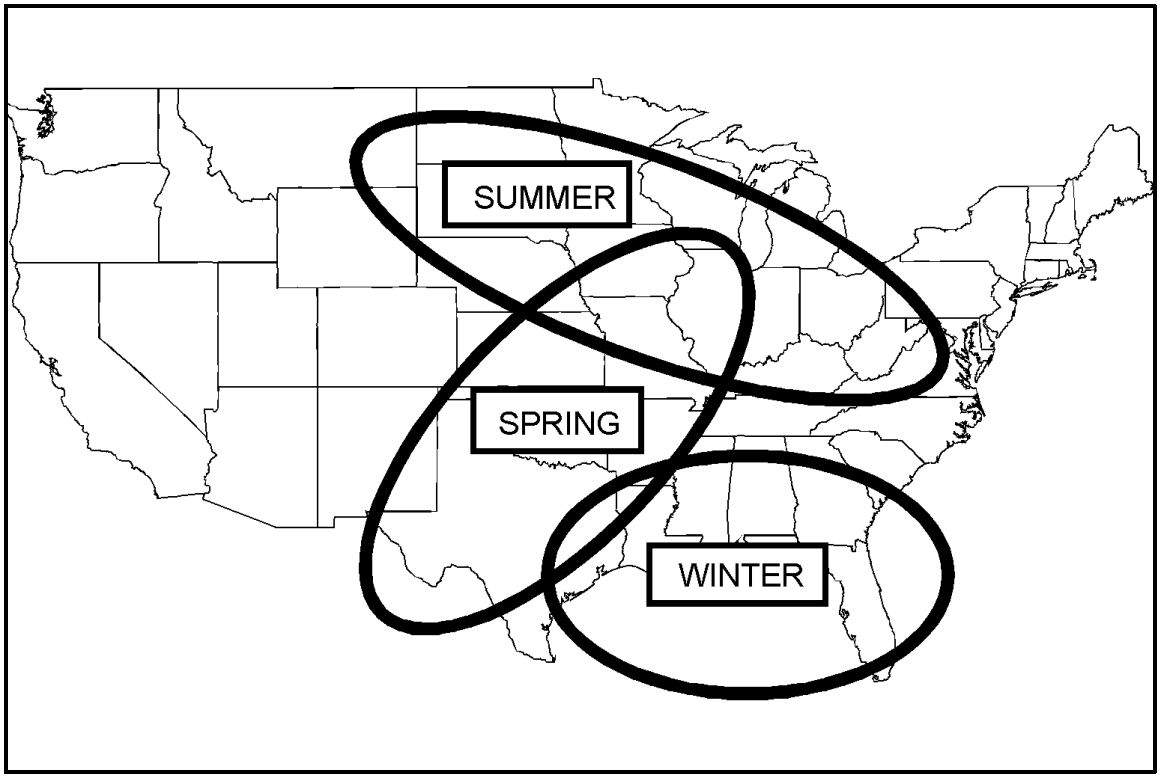

Figure 1-2: The seasonal march of severe thunderstorms.

Seasonal

The seasonal progression of thunderstorms and associated severe weather occurrences (see Figure 1-2) is closely linked to the movement of the sun, an upper level band of strong wind known as the jet stream, and large-scale weather disturbances. While thunderstorms can and do occur year-round over the Gulf Coast States, this area has a high incidence of severe weather occurrence during the winter months. Cold air intrusions from the north limit the movement of warm and moist air from the Gulf of Mexico inland, which essentially confines thunderstorm activity to the coastal regions.

By spring, when the lower layers of the atmosphere warm up faster than air in the middle and upper layers, the scene for severe thunderstorm occurrence shifts west. The Southern and Central Plains, as well as the drier Southwest, see a higher incidence of thunderstorms that reach severe levels. Anyone who has resided long in the DFW area knows that the spring is typically the most violent time of year, with a notable incidence of large hail, damaging surface wind, and tornadoes.

The summer incidence of severe thunderstorms is highest in the northern tier of states. By this time, the critically-important jet stream has migrated into this area and the northward spread of higher moisture from the southern latitudes ahead of surface frontal systems is increasingly common. Add to this the intense surface heating of this interior section of the country and you have all the necessary ingredients for outbreaks of severe thunderstorms.

Diurnal

Figure 1-3 clearly shows that the time of maximum thunderstorm occurrence, on average, is in the late afternoon and early evening. This would point to afternoon surface heating as a major contributor to their formation. This is most notable in the Southern and Central Plains, but is less obvious over the Southeast. The proximity of the Atlantic Ocean and Gulf of Mexico provide for a more moist environment and abundant cloud cover that would seemingly limit surface heating. However, it is this availability of moisture that allows for thunderstorm initiation to occur at a much lower surface temperature, and thus at an earlier time of the day.

Other factors do come into play that periodically alter the typical diurnal profile. Large-scale weather disturbances (upper-level low pressure systems, surface fronts, etc.) can traverse an area anytime during the day or night and trigger thunderstorm development. The influence of orographic features (mountains, ridges, etc.) also can also cause departures from the daily cycle.

A major trigger mechanism for thunderstorm development in the Central and Southern Plains is the dryline (a surface boundary that separates moist air from the Gulf of Mexico and hot, dry air from the Desert Southwest and northern Mexico). This feature will be discussed in detail in Module 2. For now, suffice to say that it moves west to east during the day, often arriving in the DFW area during the evening hours. This explains why we often see nighttime thunderstorm occurrences in and around DFW during the spring months.

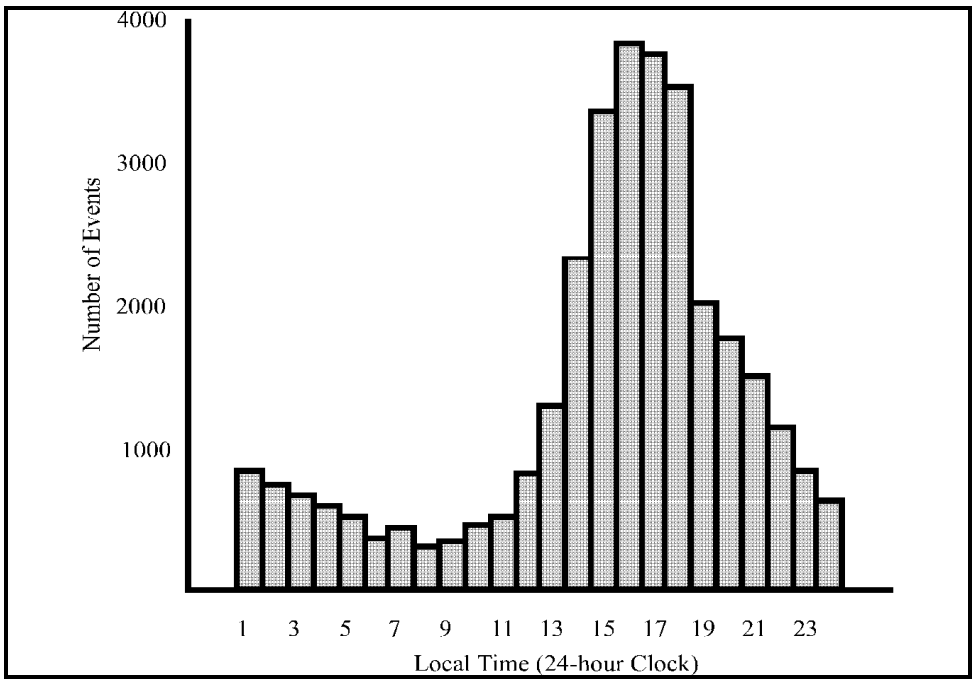

Figure 1-3: The diurnal distribution of thunderstorms across the United States. Times are local based on a 24-hour clock.